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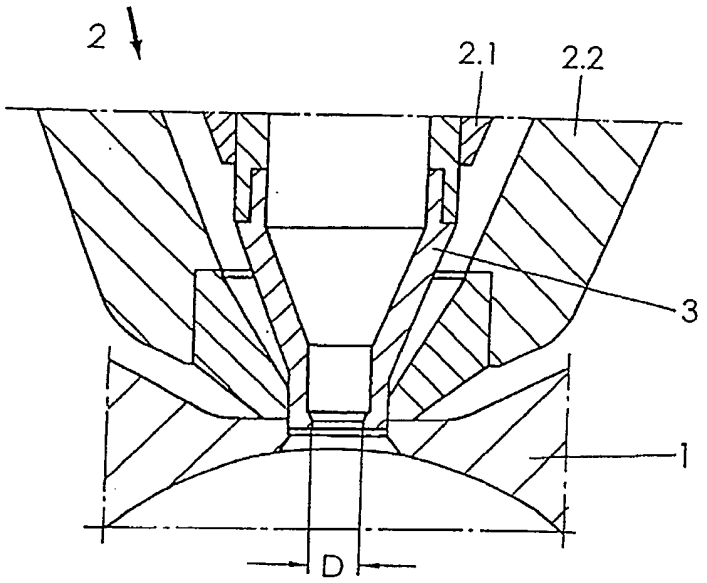
(54) **METHODE POUR LE MOULAGE SOUS PRESSION D'OBJETS A TROIS COUCHES ET APPAREIL POUR LA REALISATION DE CETTE METHODE**

(54) **METHOD FOR DIE CASTING OF THREE-LAYER ARTICLES AND APPARATUS FOR CARRYING OUT THE METHOD**



(57) Une méthode de moulage par injection de produits moulés à trois couches, et surtout des ébauches de bouteille, comportant une couche interne et externe d'un « matériau A », PET (polyéthylène téréphtalate) par exemple, et une couche intermédiaire d'un « matériau B », PET recyclé par exemple. La méthode fait intervenir un dispositif comportant au moins un moule (1). Le moule comporte plusieurs empreintes et au moins une plaque à canaux chauffés. On compte une buse pour chaque empreinte du moule. Une aiguille de fermeture de la buse fait le va-et-vient à l'intérieur de chacune des buses. Un des matériaux, soit le matériau A soit le matériau B, est injecté par un canal d'injection de matière fondue dans l'aiguille de fermeture de la buse (3) et l'autre matériau, soit le matériau B soit le matériau A, est injecté par un canal d'injection de matière fondue dans l'espace entre le coeur (2.1) et l'enveloppe (2.2) de la buse (2).

(57) A method of injection molding three-layer moldings, especially bottle blanks, with an inner and an outer layer of a "material A", PET (polyethylene terephthalate) for example, and a middle layer of a "material B", recycled PET for example. The method employs a device with at least one mold (1). The mold has several mold cavities and at last one hot-runner plate. There is a nozzle for each mold cavity. A nozzle-closing needle travels back and forth inside each nozzle. One of the materials, either material A or material B, is injected through a melt-injection channel in the nozzle-closing needle (3) and the other material, either material B or material A is injected through a melt-injection channel in the gap between the heart (2.1) and the jacket (2.2) of the nozzle (2).

Abstract

A method of injection molding three-layer moldings, especially bottle blanks, with an inner and an outer layer of a "material A", PET (polyethylene terephthalate) for example, and a middle layer of a "material B", recycled PET for example. The method employs a device with at least one mold (1). The mold has several mold cavities and at last one hot-runner plate. There is a nozzle for each mold cavity. A nozzle-closing needle travels back and forth inside each nozzle. One of the materials, either material A or material B, is injected through a melt-injection channel in the nozzle-closing needle (3) and the other material, either material B or material A is injected through a melt-injection channel in the gap between the heart (2.1) and the jacket (2.2) of the nozzle (2).

CLAIMS

1. A method for injection molding a three-layer molded article having an inner layer and an outer layer of a first material, and a middle layer of a second material; providing at least one mold having a plurality of mold cavities and at least one hot-runner plate; providing a needle-controlled nozzle for each mold cavity, said nozzle having an interior and being closeable by a needle; providing said nozzle with a jacket and a space between said jacket and the interior of said nozzle; injecting one of said materials through said needle; and injecting the other one of said materials into said mold through said space between said jacket and said interior.

2. A method as defined in claim 1, wherein said articles are bottle blanks.

3. A method as defined in claim 1, wherein said first material is polyethylene terephthalate.

4. A method as defined in claim 1, wherein said second material is recycled polyethylene terephthalate.

5. A method as defined in claim 1, including the steps of: providing said mold with a gate; advancing said needle and in contact with said jacket while injecting said first material through said needle for forming said inner and outer layers; retracting said needle and forming said middle layer by injecting

said second material through said space; and compressing thereafter said second material; decompressing said second material; advancing again said needle until said needle contacts said jacket and injection of said second material is thereby discontinued; sealing said gate; and removing the molded article from the mold.

6. A method as defined in claim 1, including the steps of: providing said mold with a gate; retracting said needle while injecting said first material through said space for forming said inner and outer layers; advancing said needle until said needle contacts said jacket and injection of said first material is thereby discontinued; injecting said second material through said needle and compressing thereafter said second material; decompressing said second material and retracting said needle; sealing said gate; and removing the molded article from the mold.

7. Apparatus for injection molding a three-layer molded article having an inner layer and an outer layer of a first material, and a middle layer of a second material, comprising: at least one mold having a plurality of mold cavities and at least one nozzle holder; a needle-controlled nozzle for each mold cavity, said nozzle having an interior and being closeable by a needle; said needle being hollow; a jacket on said nozzle and a space between said jacket and the interior of said nozzle; one of said materials being injected through said needle and the other one of said materials being injected into said mold through said space between said jacket and said interior.

8. Apparatus as defined in claim 7, wherein said hollow needle has an exit end with an inside diameter in a range of substantially 2 to 3 mm.

9. Apparatus as defined in claim 8, wherein said mold has an entrance and said needle has a forward end substantially narrower than said entrance of said mold for sealing said entrance by moving said needle into said entrance.

10. Apparatus as defined in claim 7, including a ring in said jacket, said ring having a section facing the mold with a diameter in a range of substantially 2 to 3 mm; said needle having an advanced position and a forward end resting against said ring in said advanced position.

11. A method for injection molding a three-layer molded article having an inner layer and an outer layer of a first material, and a middle layer of a second material; providing at least one mold having a plurality of mold cavities and at least one hot-runner plate; providing a needle-controlled nozzle for each mold cavity, said nozzle having an interior and being closeable by a needle; providing said nozzle with a jacket and a space between said jacket and the interior of said nozzle; injecting one of said materials through said needle; and injecting the other one of said materials through said needle; and injecting the other one of said materials into said mold through said space between said jacket and said interior; said articles being bottle blanks; said first

material being polyethylene terephthalate; said second material being recycled polyethylene terephthalate.

12. A method as defined in claim 11, including the steps of: providing said mold with a gate; advancing said needle and in contact with said jacket while injecting said first material through said needle for forming said inner and outer layers; retracting said needle and forming said middle layer by injecting said second material through said space; and compressing thereafter said second material; decompressing said second material; advancing again said needle until said needle contacts said jacket and injection of said second material is thereby discontinued; sealing said gate; and removing the molded article from the mold.

13. A method as defined in claim 11, including the steps of: providing said mold with a gate; retracting said needle while injecting said first material through said space for forming said inner and outer layers; advancing said needle until said needle contacts said jacket and injection of said first material is thereby discontinued; injecting said second material through said needle and compressing thereafter said second material; decompressing said second material and retracting said needle; sealing said gate; and removing the molded article from the mold.

14. Apparatus for injection molding a three-layer molded article having an inner layer and an outer layer of a first material, and a middle layer of a s cond material, comprising: at

least one mold having a plurality of mold cavities and at least one nozzle holder; a needle-controlled nozzle for each mold cavity, said nozzle having an interior and being closeable by a needle; said needle being hollow; a jacket on said nozzle and a space between said jacket and the interior of said nozzle; one of said materials being injected through said needle and the other one of said materials being injected into said mold through said space between said jacket and said interior; said hollow needle having an exit end with an inside diameter in a range of substantially 2 to 3 mm; said mold having an entrance and said needle having a forward end substantially narrower than said entrance of said mold for sealing said entrance by moving said needle into said entrance; a ring in said jacket, said ring having a section facing the mold with a diameter in a range of substantially 2 to 3 mm; said needle having an advanced position and a forward end resting against said ring in said advanced position.

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METHOD OF INJECTION MOLDING THREE-LAYER MOLDINGS AND DEVICE FOR CARRYING OUT THE METHOD

The present invention concerns a method of injection molding three-layer moldings, especially bottle blanks, with an inner and an outer layer of a "material A", PET (polyethylene terephthalate) for example, and a middle layer of a "material B", recycled PET for example. The method employs a device with at least one mold. The mold has several mold cavities and at last one hot-runner plate. There is a nozzle for each mold cavity. A nozzle-closing needle travels back and forth inside each nozzle. The present invention also concerns this device.

The present invention, however, is not limited to bottle blanks or to PET. It can also be applied to the injection molding of moldings for any other purpose out of any other plastic or combination of plastics. The invention can for example be employed for injection molding multiple-layer blanks from a combination of PET and PEN (polyethylene naphthalate). PEN, like PET, is a polyester, although it has much better heat-resistance, overall mechanical, and barrier properties, The material is fairly new but has already been approved by the authorities in various countries as a packaging material in the foodstuffs industry. Due to its outstanding properties, even relatively low levels of PEN, 10 to 20 % by weight of the blank, noticeably improve the quality of the bottles. Bottles made of a combination of PET and PEN are

particularly appropriate for example for hot bottling fruit juices and for storage in hot countries.

The middle layer in the aforesaid blanks constitutes a core, and the inner and outer layers a continuous skin.

The aforesaid known method will now be described. First, the material A that the inner and outer layers are made of is injected into the mold through the nozzle. The material B that the middle layer is made of is then injected. Next, the material A is dwell compressed to ensure that the molten material A employed in the next molding process will be "clean'. Some material A is sometimes forced into the hot axis of the material B during dwell compression, and the area will accordingly end up with five layers. This is undesirable and leads to more material A in the molding. The material A, however, is almost always of a higher quality and more expensive than material B.

The object of the present invention is to eliminate the drawbacks that occur when the known method is carried out and to improve the method and the device for carrying it out to the extent that the proportion of material B will be ideal for creating the middle layer.

This object is attained in accordance with the present invention

in the aforesaid method in that one of the materials, either material A or material B, is injected through the nozzle-closing needle and the other material, either material B or material A is injected through the gap between the heart and the jacket of the nozzle.

The method in accordance with the present invention exploits the principle of thermal sealing employed in what is called no-needle technology and allows the inclusion of steps ensuring that the molding's three layers will be continuous over its total length and preventing the undesired occurrence of five layers at the bottom of the molding.

One advantageous embodiment of the method in accordance with the present invention comprises the steps

creating the inner and outer layers by injecting material A through the nozzle-closing needle while the needle is advanced and in contact with the nozzle's jacket,

retracting the nozzle-closing needle and creating the middle layer by injecting material B through the gap between the nozzle's heart and its jacket and dwell compressing the material B,

decompressing the material B,

advancing the nozzle-closing needle again until it comes into contact with the nozzle's jacket and accordingly discontinuing the injection of material B,

and finally

sealing the gate and removing the molding from the mold.

The two materials are accordingly injected one after the other in this embodiment of the method in accordance with the present invention, and the third injection of material A is eliminated. Nevertheless, the molten material A to be employed for the inner and outer layers in the next molding procedure will be clean.

Another advantageous embodiment of the method in accordance with the present invention comprises the steps

creating the inner and outer layers by injecting material A through the gap between the nozzle's heart and its jacket while the nozzle-closing needle is retracted,

advancing the nozzle-closing needle until it comes into contact with the nozzle's jacket and accordingly discontinuing the injection of material A,

creating the middle layer by injecting material B through the nozzle-closing needle and dwell compressing the material B,

decompressing the material B and retracting the nozzle-closing needle,

and finally

sealing the gate and removing the molding from the mold.

The two materials are accordingly injected one after the other in this embodiment of the method in accordance with the present invention as well, and the third injection of material A is eliminated. Nevertheless, the molten material A to be employed for the inner and outer layers in the next molding procedure will be clean.

The device for carrying out the method in accordance with the

present invention has at least one mold. The mold has several mold cavities and at last one nozzle holder. There is a nozzle for each mold cavity. A nozzle-closing needle travels back and forth inside each nozzle. The needle is hollow.

Since the needle is hollow, it cannot prevent access to the cavities. This leads to precise thermal separation of the molten material A or B from the hardened molding. All that is left is a slight plug of material B at the bottom of the molding that can be broken off smooth.

The inside diameter at the exit end of the hollow nozzle-closing needle in one preferred embodiment of the device in accordance with the present invention is approximately 2 to 3 mm.

Since the forward end of the nozzle-closing needle in one even more improved embodiment of the device in accordance with the present invention is slightly narrower than the entrance into the mold, it can intrude into the entrance and seal it. The advantages are that the tolerance left to allow the needle to move need not be so precise and that the seal between the needle and the tool will be more reliable.

The forward end of the nozzle-closing needle in still another embodiment of the device in accordance with the present invention

rests in its advanced position against a ring in the nozzle's jacket, and the inside diameter of the section of the ring facing the mold is approximately 2 to 3 mm.

One embodiment of the present invention will now be specified with reference to the accompanying drawing, wherein

Figure 1 illustrates the positions occupied by the components of a nozzle during the various stages of a method carried out in accordance with one injection technique,

Figure 2 is a graph representing the changes in pressure that occur while the method is being carried out,

Figure 3 illustrates the positions occupied by the components of a nozzle during the various stages of a method carried out in accordance with another injection technique,

Figure 4 is a graph representing the changes in pressure that occur while that method is being carried out,

Figure 5 illustrates the front of a nozzle and part of an adjacent mold,

and

Figure 6 illustrates the front of another type of nozzle and part of an adjacent mold.

Each of the embodiments illustrated in Figures 1 and 3 includes a mold 1 and a nozzle 2. Nozzle 2 comprises a heart 2.1 and a jacket 2.2. A nozzle-closing needle 3 slides back and forth inside heart 2.1, There is a molding 4 in mold 1.

In the embodiment illustrated in Figure 1, a material A is injected into mold 1 through nozzle-closing needle 3 and a material B through the gap between the heart 2.1 and the jacket 2.2 of nozzle 2.

In the embodiment illustrated in Figure 3 on the other hand the material A is injected into mold 1 through the gap between the heart 2.1 and the jacket 2.2 of nozzle 2 and the material B through nozzle-closing needle 3.

Figures 1 and 2 illustrate the method recited in Claim 2 and Figures 3 and molding 4 the method recited in Claim 3. The various steps in the methods are indicated by Roman numerals I through V.

The methods illustrated in Figures 1 and 3 will be comprehensible from the hatching even without specification, as are the changes in pressure represented in Figures 2 and 4. The pressures exerted

on material A are indicated in Figures 2 and 4 by the continuous curve and those exerted on material B by the discontinuous curve.

Figures 5 and 6 illustrate the front of a nozzle 2 with a heart 2.1 and a jacket 2.2. A nozzle-closing needle 3 slides back and forth inside heart 2.1. Part of the adjacent mold 1 is also illustrated.

As will be evident from Figure 5, the outside diameter of the forward end of nozzle-closing needle 3 is slightly longer than the inside diameter of the entrance to mold 1. The forward end of the needle can accordingly intrude into the entrance. The inside diameter of nozzle-closing needle 3 at its exist is labeled "D".

In contrast to Figure 5, the forward end of the advanced nozzle-closing needle 3 rests against a ring 5 inserted into the jacket 2.2 of nozzle 2. Ring 5 itself rests against mold 1. In this case it is the inside diameter of the section of ring 5 facing mold 1 that is labeled "D".

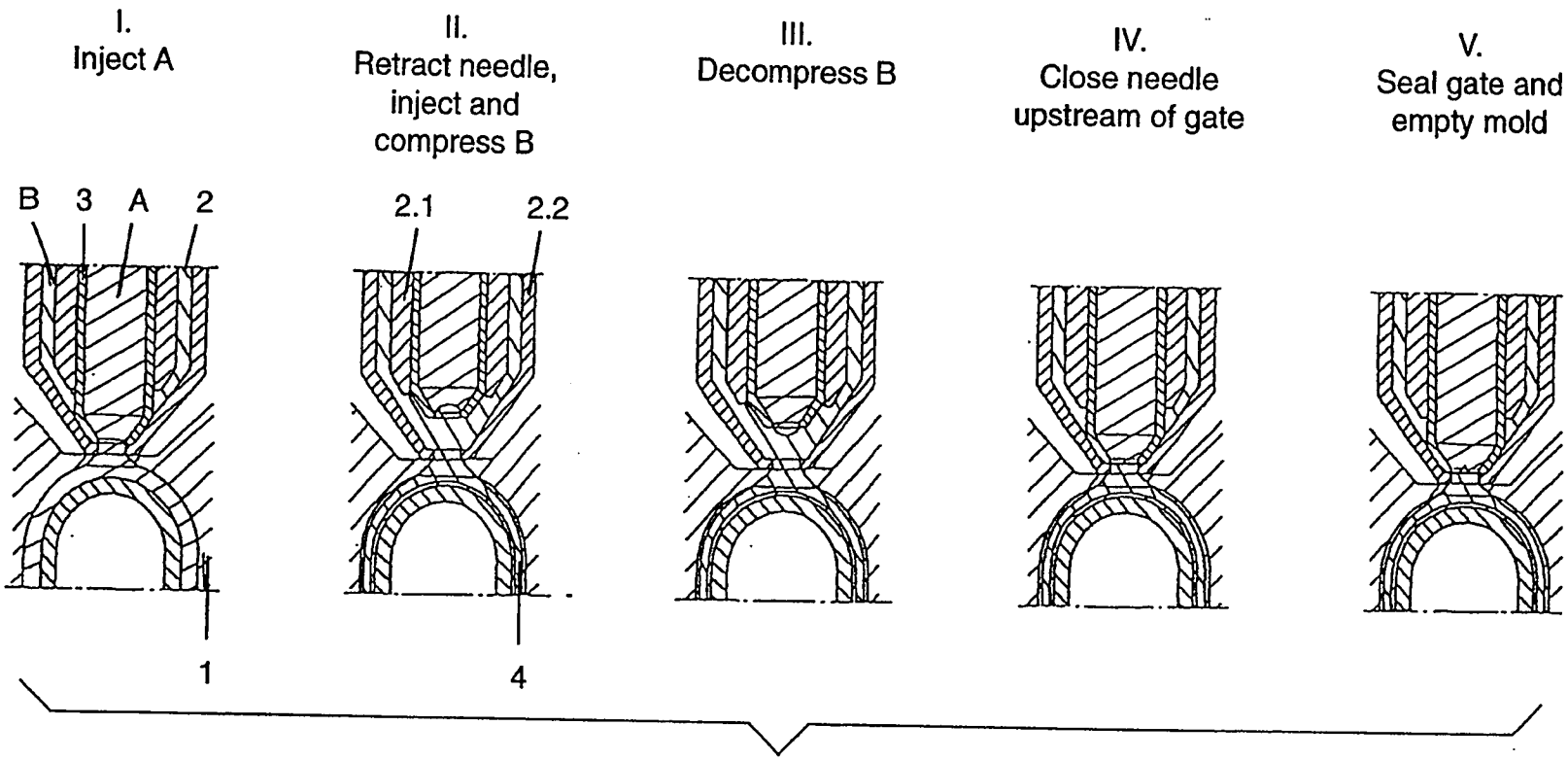

Fig. 1

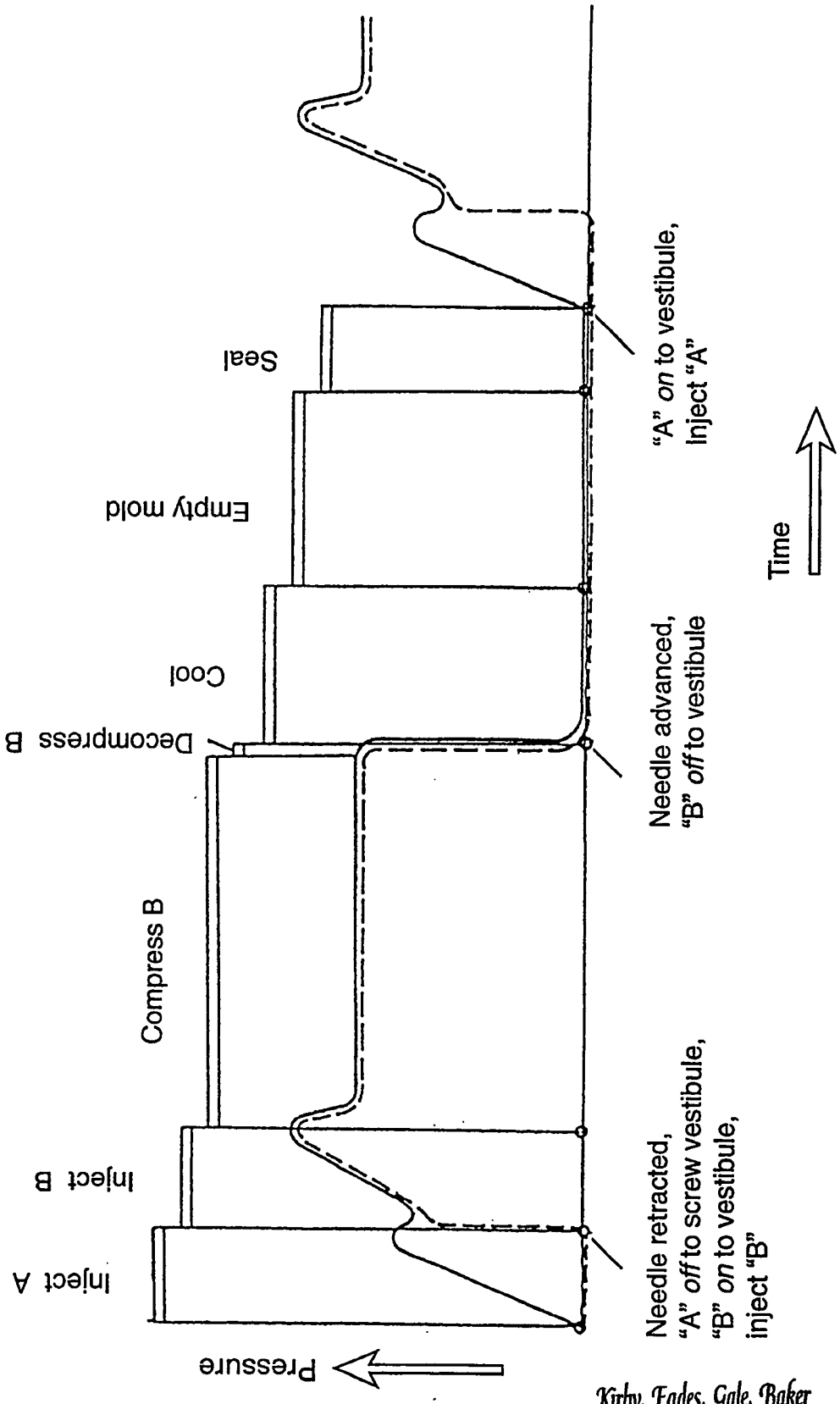

Fig. 2

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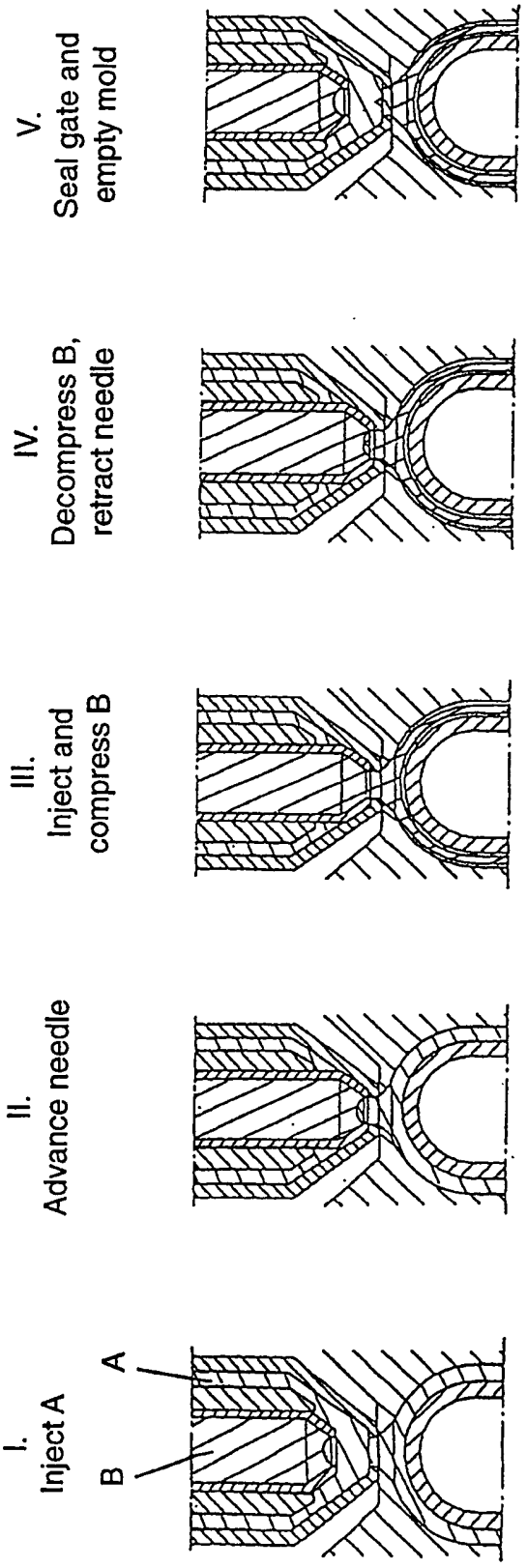
I.
Inject A
A
B
II.
Advance needle
III.
Inject and
compress B
IV.
Decompress B,
retract needle
V.
Seal gate and
empty mold

Fig. 3

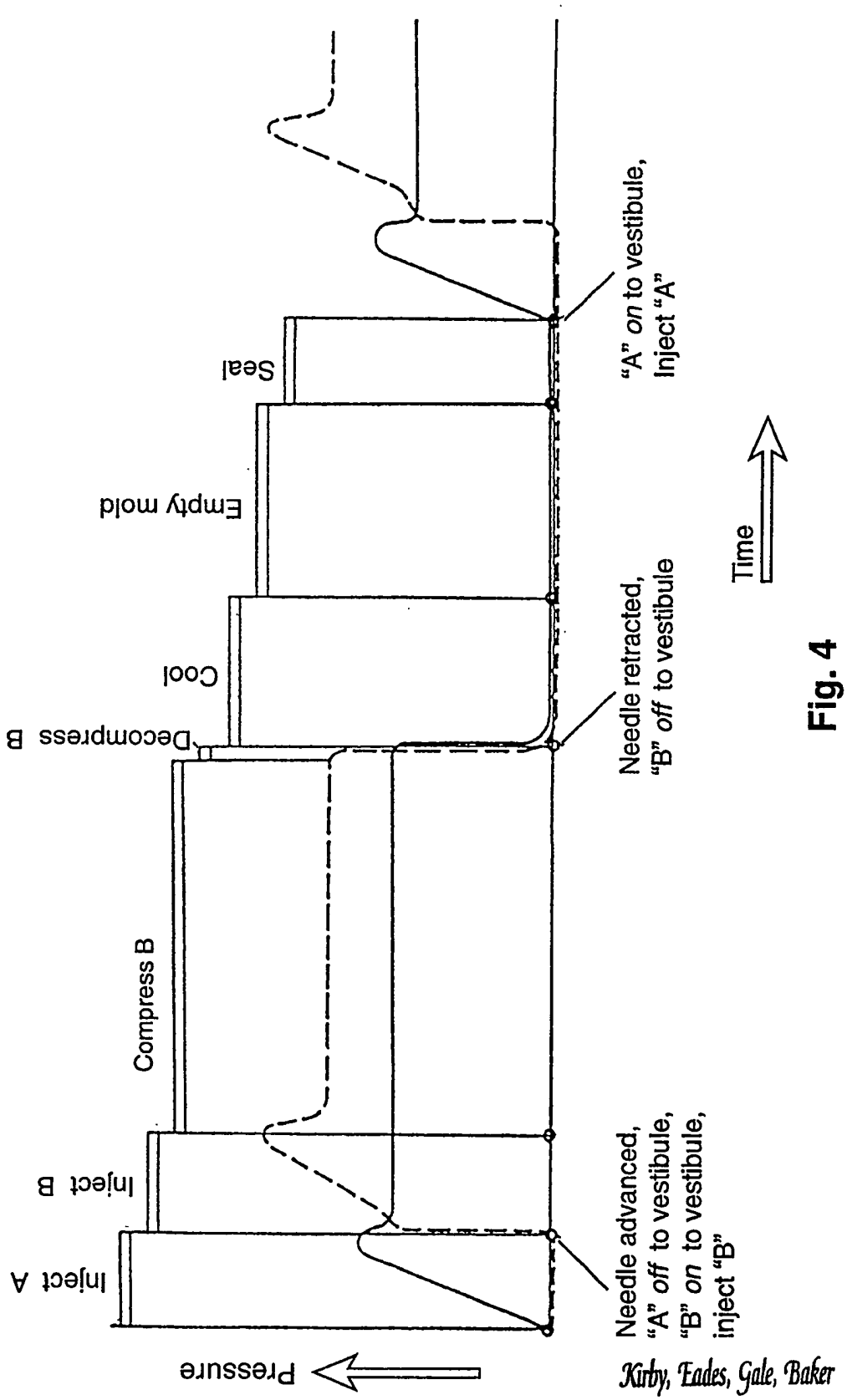

Fig. 4

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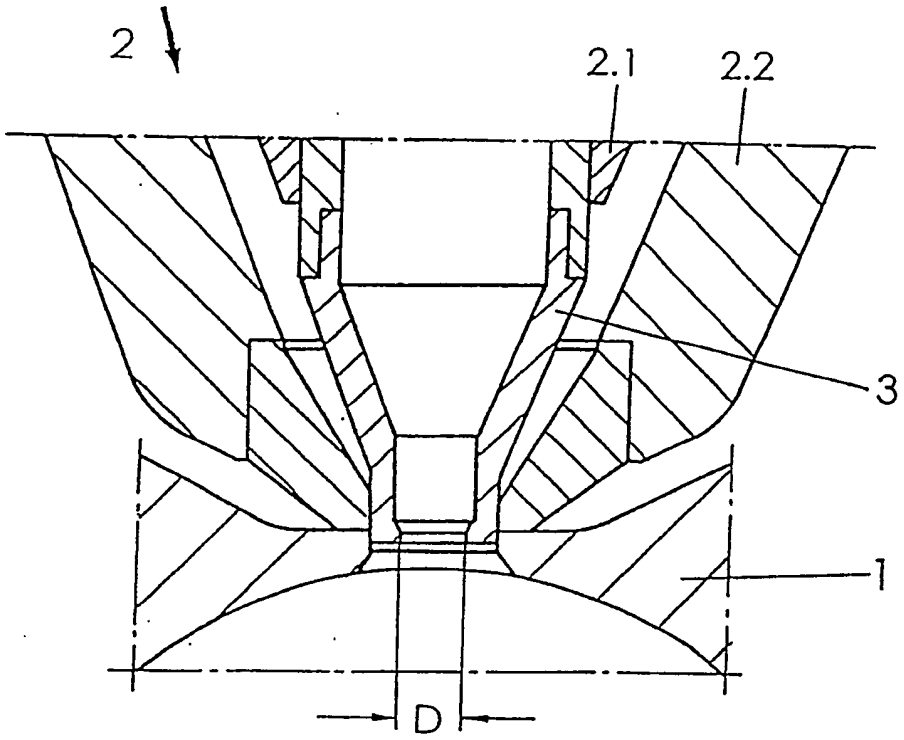

FIG. 5

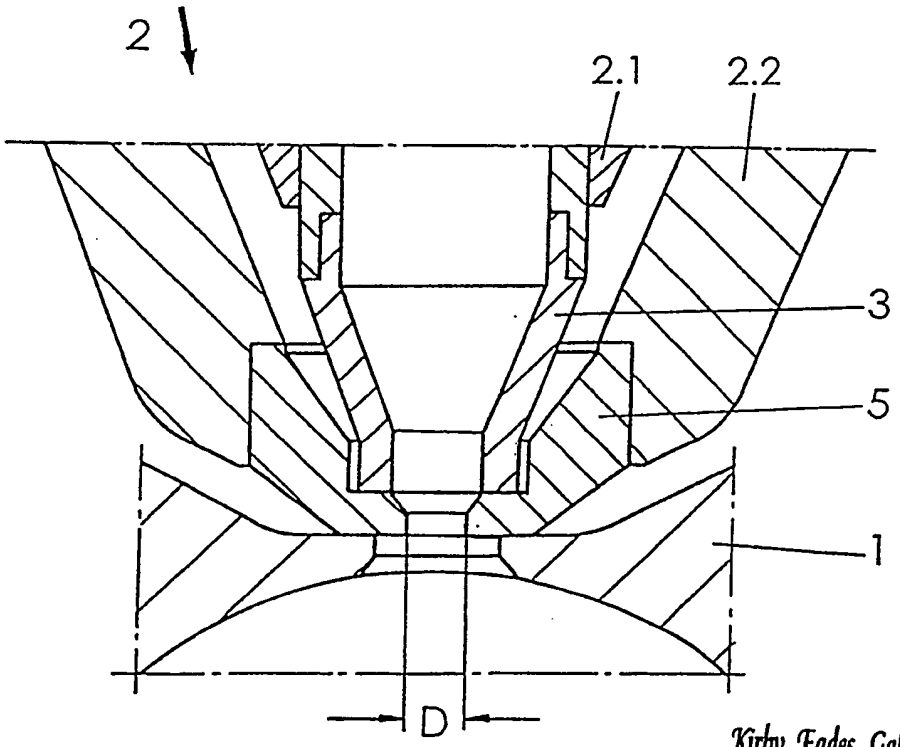

FIG. 6